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(Reaffirmed 2001)

SPECIFICATION FOR
STEEL BALLS FOR ROLLING BEARINGS

(First Revision)

Bearings Sectional Committee, EDC 39 [Ref : Doc : EDC 39 (2498)]

1. Scope

1.1 This standard lays down the requirements for finished steel balls used in rolling contact bearings and also as separate details in machines and instruments.

1.1.1 This standard does not cover corrosion-resistant steel balls.

2. Terminology

2.0 The following definitions, in addition to the relevant definitions of IS : 2399-1964 'Glossary of terms relating to rolling bearings', shall apply.

2.1 *Nominal Ball Diameter, D_w* — The diameter value which is used for the purpose of general identification of a ball size.

2.2 *Single Diameter of a Ball, D_{ws}* — The distance between two parallel planes tangent to the surface of the ball.

2.3 *Mean Diameter of a Ball, D_{wm}* — The arithmetic mean of the largest and the smallest actual single diameters of the ball.

2.4 *Ball Diameter Variation, V_{Dws}* — The difference between the largest and the smallest actual single diameters of one ball.

2.5 *Deviation from Spherical Form* — The greatest radial distance in any radial plane between a sphere circumscribed around the ball surface and any point on the ball surface.

2.5.1 Information regarding the measurement of the deviation from spherical form is given in Appendix A.

2.6 *Lot* — A definite quantity of balls manufactured under conditions which are presumed uniform and which is considered as an entity.

2.7 *Lot Mean Diameter, D_{wmL}* — The arithmetic mean of the mean diameter of the largest ball and that of the smallest ball in the lot.

2.8 *Lot Diameter Variation, V_{DwL}* — The difference between the mean diameter of the largest ball and that of the smallest ball in the lot.

2.9 *Ball Grade* — A specific combination of dimensional, form, surface roughness, and sorting tolerances. A ball grade is identified by a grade number (*see* 5).

2.10 *Ball Gauge, S* — The amount by which a lot mean diameter should differ from the nominal ball diameter, this amount being one of an established series.

2.10.1 Each ball gauge is a whole multiple of the ball gauge interval established for the ball grade in question (*see also* Appendix B).

2.10.2 A ball gauge, in combination with the ball grade and nominal diameter, should be considered as the most exact ball size specification to be used by a customer for ordering purposes.

2.11 *Deviation from Ball Gauge, ΔS* — The difference between the lot mean diameter and the sum of the nominal diameter and the ball gauge (*see also* Appendix B).

$$\Delta S = D_{wmL} - (D_w + S)$$

2.12 *Ball Subgauge* — The amount, of an established series of amounts, which is nearest to the actual deviation from a ball gauge.

2.12.1 Each ball subgauge is a whole multiple of the ball subgauge interval established for the ball grade in question (*see also* Appendix B).

2.12.2 The ball subgauge, in combination with the nominal ball diameter and the ball gauge, is used by ball manufacturers to denote the lot mean diameter and should not be used by customers for ordering purposes.

Adopted 26 May 1976

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2.13 *Surface Roughness* — All those irregularities of the surface which are conventionally defined within a section of the area where deviations of form and waviness are eliminated.

2.13.1 The surface roughness tolerance values given in Table 2 refer to the arithmetical mean deviation, R_a, from the mean line of the profile, evaluated according to the method specified in IS : 3073-1967 'Assessment of surface roughness'.

2.14 *Hardness* — The measure of resistance to penetration as determined by specific methods.

2.15 *Unit Container* — An individual container which contains ball of the same material, specific diameter and grade.

3. Material

3.1 The balls shall be manufactured from suitable material conforming to IS : 4398-1972 'Carbon-chromium steel for the manufacture of balls, rollers and bearing races'.'

3.2 The metal employed for rolling bearings shall be free from defects, such as pipes, seams, laminations, excessive inclusion of non-metallic impurities and such other internal defects as would render the material unsuitable for the purpose for which it is intended.

4. Dimensions — The preferred nominal ball diameter shall be as given in Table 1.

TABLE 1 PREFERRED BALL SIZES

All dimensions in millimetres.

Nominal Ball Diameter D_w	Diameter for Subgauge 0 of Gauge 0	Nominal Ball Diameter D_w	Diameter for Subgauge 0 of Gauge 0	Nominal Ball Diameter D_w	Diameter for Subgauge 0 of Gauge 0
0·3	0·300 00	11·5	11·500 00	34	34·000 00
0·4	0·400 00	11·906	11·906 25	34·925	34·925 00
0·5	0·500 00	12	12·000 00	35	35·000 00
0·508	0·508 00	12·700	12·700 00	36	36·000 00
0·6	0·600 00	13	13·000 00	36·512	36·512 50
0·635	0·635 00	13·494	13·493 75	38	38·000 00
0·7	0·700 00	14	14·000 00	38·100	38·100 00
0·794	0·793 75	14·288	14·287 50	39·688	39·687 50
0·8	0·800 00	15	15·000 00	40	40·000 00
1	1·000 00	15·081	15·081 25	41·275	41·275 00
1·2	1·200 00	15·875	15·875 00	42·862	42·862 50
1·5	1·500 00	16	16·000 00	44·450	44·450 00
1·588	1·587 50	16·669	16·668 75	45	45·000 00
2	2·000 00	17	17·000 00	46·038	46·037 50
2·381	2·381 25	17·462	17·462 50	47·625	47·625 00
2·5	2·500 00	18	18·000 00	49·212	49·212 50
3	3·000 00	18·256	18·256 25	50	50·000 00
3·175	3·175 00	19	19·000 00	50·800	50·800 00
3·5	3·500 00	19·050	19·050 00	53·975	53·975 00
3·969	3·968 75	19·844	19·843 75	55	55·000 00
4	4·000 00	20	20·000 00	57·150	57·150 00
4·5	4·500 00	20·638	20·637 50	60	60·000 00
4·762	4·762 50	21	21·000 00	60·325	60·325 00
5	5·000 00	21·431	21·431 25	63·500	63·500 00
5·5	5·500 00	22	22·000 00	65	65·000 00
5·556	5·556 25	22·225	22·225 00	66·675	66·675 00
6	6·000 00	23	23·000 00	69·850	69·850 00
6·350	6·350 00	23·019	23·018 75	73·025	73·025 00
6·5	6·500 00	23·812	23·812 50	76·200	76·200 00
7	7·000 00	24	24·000 00	79·375	79·375 00
7·144	7·143 75	24·606	24·606 25	82·550	82·550 00
7·5	7·500 00	25	25·000 00	85·725	85·725 00
7·938	7·937 50	25·400	25·400 00	88·900	88·900 00
8	8·000 00	26	26·000 00	92·075	92·075 00
8·5	8·500 00	26·988	26·987 50	95·250	95·250 00
8·731	8·731 25	28	28·000 00	98·425	98·425 00
9	9·000 00	28·575	28·575 00	101·600	101·600 00
9·525	9·525 00	30	30·000 00	104·775	104·775 00
10	10·000 00	30·162	30·162 50	107·950	107·950 00
10·319	10·318 75	31·750	31·750 00	111·125	111·125 00
11	11·000 00	32	32·000 00	114·300	114·300 00
11·112	11·112 50	33·338	33·337 50		

5. Grades — The balls shall be classified into grades, determined by the degree of precision and surface finish, as detailed in Table 2.

TABLE 2 FORM AND SURFACE ROUGHNESS TOLERANCES

(*Clauses* 2.13.1, 5, 9.2, 11.1.8 *and* 11.1.9)

Grade	Ball Diameter Variation V_{DWs}	Deviation from Spherical Form	Surface Roughness R_a
	Maximum Values in Micrometres		
3	0·08	0·08	0·012
5	0·13	0·13	0·02
10	0·25	0·25	0·025
16	0·4	0·4	0·032
20	0·5	0·5	0·04
28	0·7	0·7	0·05
40	1	1	0·08
100	2·5	2·5	0·125
200	5	5	0·2

6. Sorting Accuracy and Ball Gauges — The preferred gauges and subgauges, gauge and subgauge intervals and lot diameter variation shall conform to Table 3. An example to illustrate the significance is shown in Appendix B.

TABLE 3 SORTING TOLERANCES AND GAUGES

Grade	Lot Diameter Variation $V_{DWL\,Max}$	Gauge Interval	Preferred Gauges	Sub-gauge Interval	Subgauges
	Values in Micrometres				
3	0·13	0·5	− 5, .. − 0·5, 0, + 0·5, .. + 5	0·1	−0·2, −0·1, 0, +0·1, +0·2
5	0·25	1	− 5, .. − 1, 0, + 1, .. + 5	0·2	−0·4, −0·2, 0, +0·2, +0·4
10	0·5	1	− 9, .. − 1, 0, + 1, .. + 9	0·2	−0·4, −0·2, 0, +0·2, +0·4
*16	0·8	2	−10, .. − 2, 0, + 2, .. +10	0·4	−0·8, −0·4, 0, +0·4, +0·8
*20	1	2	−10, .. − 2, 0, + 2, .. +10	0·4	−0·8, −0·4, 0, +0·4, +0·8
*28	1·4	2	−12, .. − 2, 0, + 2, .. +12	0·4	−0·8, −0·4, 0, +0·4, +0·8
40	2	4	−16, .. − 4, 0, + 4, .. +16	0·8	−1·6, −0·8, 0, +0·8, +1·6
100	5	10	−40, .. −10, 0, +10, .. +40	2	−4, −2, 0, +2, +4
200	10	15	−60, .. −15, 0, +15, .. +60	3	−6, −3, 0, +3, +6

*In exceptional cases and after agreement between purchaser and supplier, half the gauge and subgauge interval values may be used for Grades 16, 20 and 28.

7. Ball Grade Application — The preferred range of ball sizes to which the different ball grades should be applied is given in Table 4.

TABLE 4 APPLICABILITY OF BALL GRADES

Grade	Preferred Range of Nominal Ball Diameters to which the Grade is Applicable, mm	
	Over	Including
3	—	12
5	—	12
10	—	25
16	—	25
20	—	38
28	—	38
40	—	50
100	—	All
200	—	All

8. Hardness

8.1 The hardness of the finished balls shall be between 60 and 67 *HRC* as measured on parallel flats [*see* IS : 1586-1960 Methods for Rockwell hardness test (B and C scales) for steel (*first revision*)].

8.2 In view of the difficulty in producing parallel flats, hardness shall be measured on the curved surface of the ball and a correction as given in Table 5 shall be added to the reading obtained.

TABLE 5 CORRECTION TO BE ADDED TO ROCKWELL 'C' READINGS OBTAINED ON SPHERICAL SURFACES

Ball Size	Hardness (*HRC*) Readings												
mm	55	56	57	58	59	60	61	62	63	64	65	66	67
6·350	4·1	3·8	3·6	3·3	3·1	2·9	2·7	2·5	2·3	2·1	1·8	1·6	1·5
7	3·7	3·4	3·2	3·0	2·8	2·6	2·4	2·2	2·0	1·8	1·6	1·4	1·3
7·938	3·1	2·9	2·7	2·6	2·4	2·2	2·0	1·9	1·7	1·5	1·3	1·1	1·0
8	3·1	2·9	2·7	2·6	2·4	2·2	2·0	1·9	1·7	1·5	1·3	1·1	1·0
9	2·7	2·5	2·4	2·2	2·0	1·9	1·7	1·5	1·4	1·2	1·1	1·0	0·9
9·525	2·5	2·3	2·2	2·0	1·9	1·8	1·6	1·4	1·2	1·1	1·0	0·9	0·8
10	2·4	2·2	2·0	1·9	1·8	1·7	1·5	1·3	1·1	1·0	0·9	0·8	0·7
11	2·1	2·0	1·8	1·7	1·6	1·5	1·3	1·1	0·9	0·8	0·7	0·6	0·6
12	1·9	1·7	1·6	1·5	1·4	1·3	1·1	1·0	0·8	0·7	0·6	0·5	0·5
12·700	1·8	1·7	1·6	1·5	1·4	1·2	1·0	0·9	0·7	0·6	0·5	0·5	0·5
13	1·8	1·7	1·6	1·5	1·4	1·2	1·0	0·9	0·7	0·6	0·5	0·4	0·4
14	1·6	1·5	1·4	1·3	1·2	1·0	0·9	0·8	0·6	0·5	0·4	0·4	0·3
15	1·5	1·4	1·3	1·2	1·1	0·9	0·8	0·7	0·5	0·4	0·3	0·3	0·2
15·875	1·4	1·3	1·2	1·1	1·0	0·9	0·8	0·7	0·5	0·4	0·3	0·3	0·2
16	1·4	1·3	1·2	1·1	1·0	0·9	0·8	0·7	0·5	0·4	0·3	0·3	0·2
17	1·3	1·2	1·1	1·0	0·9	0·8	0·7	0·6	0·4	0·3	0·2	0·2	0·1
18	1·2	1·1	1·0	0·9	0·8	0·7	0·6	0·5	0·4	0·3	0·2	0·2	0·1
19	1·1	1·0	0·9	0·8	0·7	0·7	0·6	0·5	0·4	0·3	0·2	0·2	0·1
19·050	1·1	1·1	1·0	0·9	0·8	0·7	0·6	0·5	0·4	0·3	0·2	0·1	0·1
20	1·0	1·0	0·9	0·8	0·8	0·7	0·6	0·5	0·4	0·3	0·2	0·1	0·1
25·400	0·8	0·8	0·7	0·6	0·5	0·4	0·4	0·3	0·3	0·2	0·1	0·1	0·1

Note 1 — For ball sizes and hardness values other than shown, values shall be interpolated.

Note 2 — This table is applicable to carbon-chromium steel and corrosion-resisting hardened and unhardened steel balls and carbon steel balls.

8.3 Hardness for balls less than 3 mm in nominal size shall be made by Vickers hardness test [*see* IS : 1501-1968 Method for Vickers hardness test for steel (*first revision*)] using a test load of 5 kg and converted to Rockwell hardness C scale (IS : 4258-1967 'Hardness conversion tables for metals').

9. Technical Requirements

9.1 *Quality of Surface*

9.1.1 *Surface appearance* — The balls shall be free from cracks, pits, rust and indications of soft spots visible under macroscopic inspection except Grades 3 and 5, which shall be inspected by microscopic inspection not exceeding 10 power.

9.1.2 Balls shall be subjected to visual inspection under diffused light for soft spots.

9.2 *Surface Roughness* — Balls shall have the maximum values of surface roughness as given in Table 2, when measured in accordance with IS : 3073-1967.

10. Sampling — Unless otherwise agreed upon between the purchaser and the manufacturer, the sampling plan and criteria for conformity given in Appendix C shall be followed.

11. Tests

11.1 *Dimensions* — The diameter of balls shall be determined by comparative measurements with the master balls.

11.1.1 All comparative measurements shall be made with such instruments and gauging methods which can give an accuracy of results within one-fifth of the standard tolerance of the balls or within 0·05 micron whichever is larger.

11.1.2 The master balls shall be made of a suitable steel having a hardness of 64 *HRC* or higher, with permissible diameter variation of one-tenth of the diameter tolerance per ball applicable to the particular grade or 0·05 micron whichever is larger. The calibrated diameter of the master ball shall be defined as the average of at least twenty randomly oriented diameter readings, and shall have an accuracy equal to within plus and minus the magnitude of diameter variation of the master ball or ±0·08 micron whichever is larger. Corrections shall then be applied to bring the measured values to zero contact pressure and an ambient temperature of 20°C.

11.1.3 Materials used to make gauge contacts shall be of at least the same hardness as the ball measured. All gauge contacts shall be flat or provided with a convex curvature having a radius of at least 3 mm. Pressure at any gauge contact shall not exceed 100 g for balls up to and including 25·4 mm and 200 g for larger balls. These values include effect of the weight of the balls under test.

11.1.4 The gauge pressure and temperature shall be maintained the same for the master ball and the ball under test. When the ball under test differs in material from the master ball, measurements shall be corrected to zero contact pressure and an ambient temperature of 20°C.

11.1.5 All determinations of diameter and tolerances shall be based on 10 measurements taken in random orientation on each ball in a sample.

11.1.6 Specific diameter tolerance shall be checked by computing the average of 10 measurements of each ball and determining the range of these averages for the sample of balls drawn from the same unit container.

11.1.7 Compliance to basic diameter tolerance shall be determined by using all individual diameter measurements of balls drawn from the supply.

11.1.8 The tolerances for variations and deviations for different grades of balls shall be as given in Table 2.

11.1.9 The surface roughness requirements wherever applicable shall be as given in Table 2.

11.2 *Deviation from Spherical Form* — The method given in Appendix A shall be followed.

11.3 *Crushing Load Test* — The crushing load shall be determined by holding one ball between two others and subjecting them to increasing load till the ball is crushed.

11.3.1 The method of test consists of holding three balls in contact with each other in a pair of V-guides and holding the balls vertically under a suitable loading machine. The slight pressure will hold the balls vertically in position. The V-guides shall then be removed and the load increased gradually at a rate of 1 960 to 5 880 N/sec till the ball crushed. The amount of load as recorded at this point shall be regarded as the crushing load (*see* Fig. 1) and shall not be less than the values specified for the corresponding size of ball in Table 6.

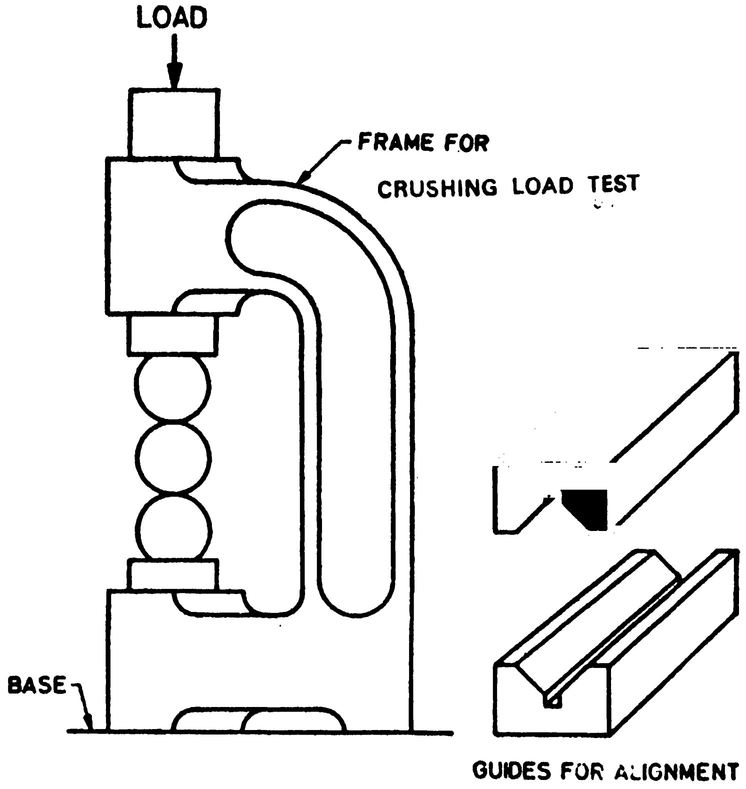


FIG. 1 CRUSHING LOAD TEST

TABLE 6 CRUSHING LOAD OF HIGH CARBON CHROMIUM ALLOY STEEL BALLS (THREE-BALL SYSTEM)

(*Clauses* 11.3.1 *and* C-2.4)

Nominal Diameter of Ball in mm	Minimum Crushing Load in *N*	Nominal Diameter of Ball in mm	Minimum Crushing Load in *N*	Nominal Diameter of Ball in mm	Minimum Crushing Load in *N*
3·175	5 390	12	76 200	24·606	298 000
3·5	6 370	12·700	83 400	25	306 000
3·969	8 430	13	87 800	25·400	319 000
4·0	8 530	13·494	94 100	26	357 000
4·5	10 600	14	10 200	26·988	358 000
4·762	12 100	14·288	105 000	28	382 000
5	13 000	15	116 000	28·575	397 000
5·5	15 800	15·081	117 000	30	432 000
5·556	16 300	15·875	129 000	30·162	441 000
6	18 800	16	131 000	31·750	487 000
6·350	21 300	16·669	142 000	32	489 000
6·5	22 000	17	149 000	33·338	534 000
7	25 500	17·462	155 000	34	558 000
7·144	27 000	18	163 000	34·925	583 000
7·5	29 300	19	181 000	35	589 000
7·938	32 900	19·050	183 000	36	614 000
8	33 300	19·844	199 000	36·512	633 000
8·5	37 700	20	200 000	38	686 000
8·731	39 700	20·638	215 000	38·100	689 000
9	42 200	21	220 000	39·688	736 000
9·525	47 100	21·431	221 000	40	752 000
10	52 100	22	241 000	41·275	799 000
10·319	55 000	22·22	247 000	42·862	853 000
11	62 800	23	255 000	44·450	912 000
11·112	63 800	23·019	258 000		
11·5	69 000	23·812	281 000		
11·906	73 500	24	287 000		

11.3.2 When agreed to by the purchaser and the supplier, balls of diameter larger than 45 mm sha be compression tested. Test load at compression and change in ball diameter caused by this load, as function of the ball size, shall correspond to the values given in Table 7.

TABLE 7 COMPRESSION TEST OF STEEL BALLS OF DIAMETER MORE THAN 45 mm

Ball Diameter, mm	50·8	60	76·2	100	101·6	152·4	203·2
Load, kN	78·4	98·6	147	245	245	490	784
Maximum Allowable Difference in Ball Diameters Measured Before and After Compression	3	3	3	4	4	6	10

11.3.3 In view of the fact that balls sometimes shatter with explosion, precautions shall be taken t protect the personnel engaged in the test against accidents.

12. Marking — Each unit container shall be marked with the lot mean diameter; grade of balls and th number of balls contained.

12.1 *Certification Marking* — Details available with the Bureau of Indian Standards.

APPENDIX A

(*Clauses* 2.5.1 *and* 11.2)

MEASUREMENT OF DEVIATION FROM SPHERICAL FORM

A-1. Method Using Roundness Measuring Instrument — Considering the wide range of sizes of steel balls for rolling bearings, from 0·3 mm to 114·3 mm, the measurement of deviation from spherical form may be a difficult and slow process requiring special equipment. In practice it is usually measured by a numerical evaluation of the ball profile, in two or three equatorial planes at 90° to each other, as recorded on a polar chart which shows the measured profiles. The measured profile is a graphical representation of the ball's radial deviations, highly magnified, which are recorded as either the ball or a contacting stylus in precisely rotated about the ball axis. The accuracy of spindle rotation and the sensitivity of the transducer shall be within 0·025 µm. Because of the high radial magnification some care shall be taken in interpreting the polar charts, and there are several commonly used procedures for finding the radial separation of the measured profile from a perfect circle. The minimum circumscribed circle method is relatively simple and is generally satisfactory for ball profiles, as is also the assumption that two or three equatorial profiles at 90° to each other are a good indication of deviation from spherical form.

A-2. Method Using Vee-Block Measurements — Deviation from spherical form in steel balls for rolling bearings may result in equatorial profiles having two or more waves or radial deviations from a perfect circle. Measuring single diameter of a ball will give a good indication of out-of-roundness for two waves or even number of waves but may fail to detect or properly measure out-of-roundness having odd numbers of waves. For medium and large balls it is practical to use a Vee-block measuring device, arranged as shown in Fig. 2, to measure the out-of-roundness of the profile having odd number of waves. The angle of the Vee has a pronounced influence on the indicator reading and no one angle is adequate for all waviness. The most practical Vee angles appear to be 90° and 120° and the magnification factor for the ratio of the indicator reading to the actual wave height of deviation from spherical form is shown in Table 8. To determine the deviation from spherical form, divide the indicator reading by this factor.

A-2.1 When the number of waves in the profile is unknown, which is most usual, readings in three planes at 90° to each other should be taken on a two-point gauge and on both the 90° and 120° Vee-gauges. Dividing the highest reading obtained on either Vee-gauge by a factor of 2 to determine the deviation from spherical form for odd numbers of waves is considered acceptable.

The point of stylus ball contact shall be on axis *A-A* which is the bisector of the Vee and axis *B-B* which is the axis of the ball; also the spindle of the indicator shall be in alignment with axes *A-A* and *B-B*.

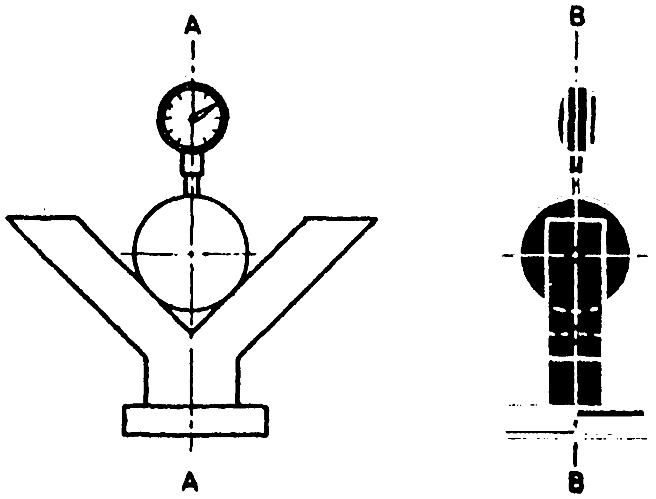


FIG. 2 VEE-BLOCK MEASURING DEVICE

TABLE 8 MAGNIFICATION FACTOR (GAUGE READING/DEVIATION FROM SPHERICAL FORM)

(*Clause* A-2)

Vee Angle	Number of Waves									
	3	5	7	9	11	13	15	17	19	21
90°	2	2	0	0	2	2	0	0	2	2
120°	1	2	2	1	0	0	1	2	2	1

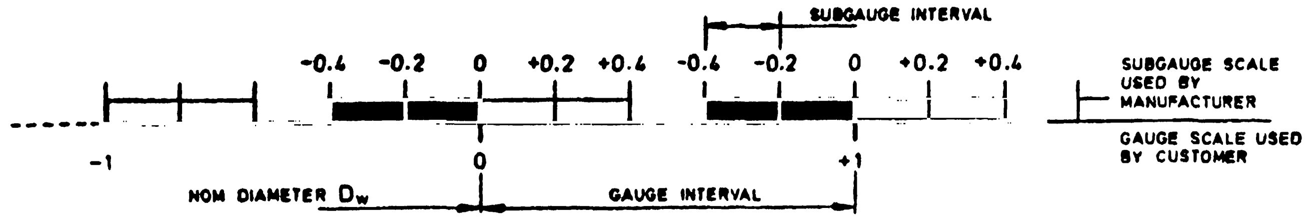
APPENDIX B

(*Clauses* 2.10.1, 2.11, 2.12.1 *and* 6)

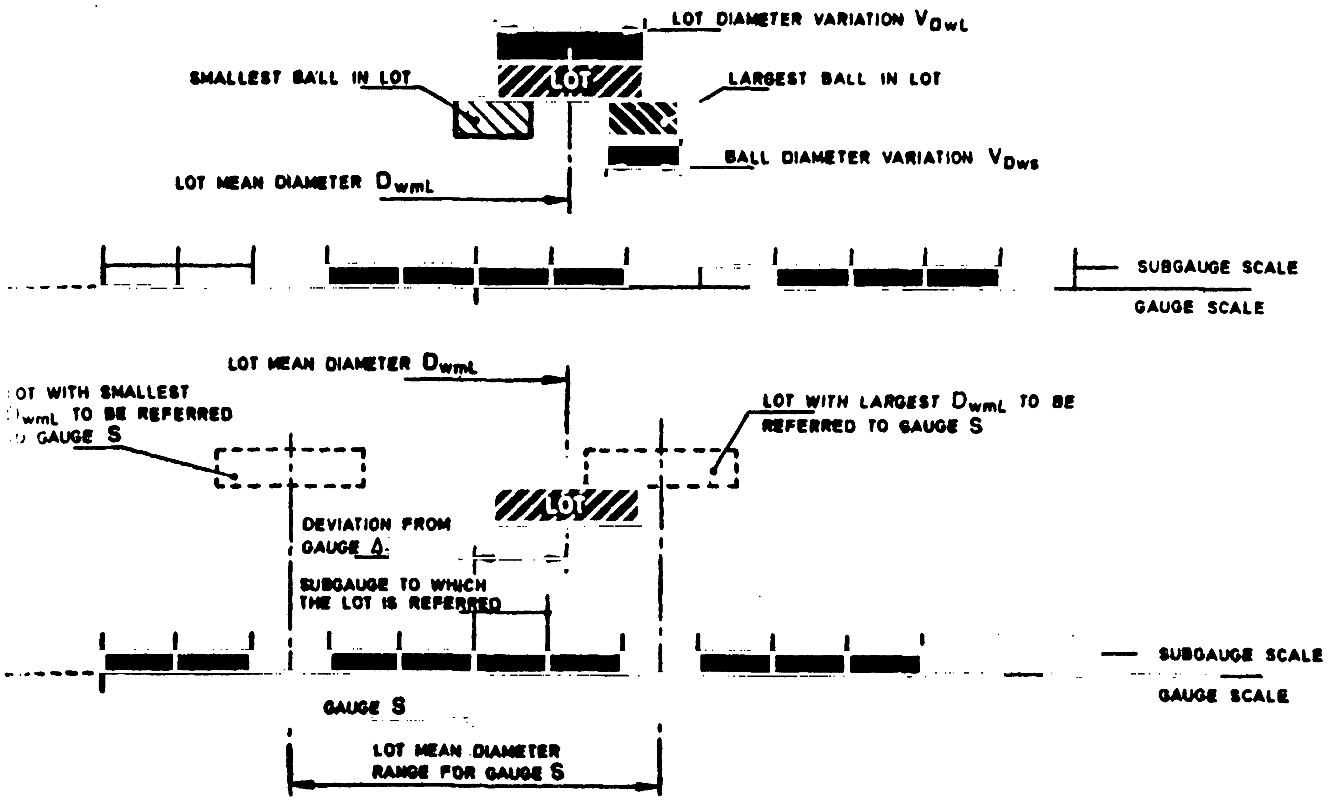
ILLUSTRATION OF GAUGES AND SORTING PRINCIPLES

B-1. Gauge and Subgauge

EXAMPLE GRADE 5, VALUES IN MICROMETRES



B-2. Lot and Gauge Deviations


LOT DIAMETER VARIATION V_{DwL}
SMALLEST BALL IN LOT
LOT
LARGEST BALL IN LOT
BALL DIAMETER VARIATION V_{Dws}
LOT MEAN DIAMETER D_{wmL}
SUBGAUGE SCALE
GAUGE SCALE
LOT MEAN DIAMETER D_{wmL}
OT WITH SMALLEST
$_{wmL}$ TO BE REFERRED
GAUGE S
LOT WITH LARGEST D_{wmL} TO BE REFERRED TO GAUGE S
LOT
DEVIATION FROM GAUGE Δ
SUBGAUGE TO WHICH THE LOT IS REFERRED
SUBGAUGE SCALE
GAUGE SCALE
GAUGE S
LOT MEAN DIAMETER RANGE FOR GAUGE S

APPENDIX C

(*Clause* 10)

SAMPLING OF STEEL BALLS AND CRITERIA FOR CONFORMITY

C-1. Scale of Sampling

C-1.1 *Lot* — All balls in a consignment belonging to the same grade, size, material and manufactured under similar conditions of production shall constitute a lot.

C-1.2 Balls shall be selected and examined from each lot separately for ascertaining their conformity to the requirements of this standard.

C-1.3 The number of balls to be selected from a lot shall depend on the size of the lot and shall be in accordance with col 1 and 2 of Table 9. The selection of these balls from the lot shall be done according to **C-1.4**.

TABLE 9 SAMPLING SIZE AND CRITERIA FOR CONFORMITY

(*Clauses* C-1.3, C-1.4, C-2.1 *and* C-2.2)

No. of Balls in the Lot N	For Requirements Other Than Crushing Load Test		No. of Balls in The Sub-sample for Crushing Load Test m
	No. of Balls in the Sample n	Permissible Number of Defectives a	
(1)	(2)	(3)	(4)
Up to 500	15	1	6
501 „ 1 000	20	1	6
1 001 „ 3 000	32	2	9
3 001 „ 10 000	50	3	12
10 001 „ 35 000	80	5	15
35 001 „ 150 000	125	7	18
150 001 „ 500 000	200	10	21
500 001 and over	315	14	24

C-1.4 In the first stage, 25 percent or *n* containers (*see* col 2 of Table 9), whichever is less, shall be selected at random from all the containers in the lot. In the second stage a sample of '*n*' balls shall be taken by picking at random equal number of balls, as far as possible, from each of the selected containers.

C-2. Number of Tests and Criteria for Conformity

C-2.1 Each of the balls selected according to **C-1.3** and **C-1.4** shall be tested for all the requirements of this standard except crushing load test. A ball failing to meet any one or more of these requirements shall be regarded as defective. The lot shall be considered as conforming to these requirements if the number of defectives in the sample does not exceed the permissible number of defectives given in col 3 of Table 9.

C-2.2 For crushing load test, a sub-sample of *m* given in col 4 of Table 9 shall be taken at random. These balls may be selected from the balls selected according to **C-1.3** and **C-1.4**. These *m* balls shall be divided into groups of 3 balls each and on each group of 3 balls, the crushing load test shall be carried out in accordance with **11.3**.

C-2.3 From the results of crushing load tests, the mean and the range shall be calculated as follows:

$$\text{Mean } (\bar{X}) = \frac{\text{Sum of the test results}}{\text{Number of test results}}, \text{ and}$$

Range (R) = Difference between the highest and the lowest value obtained from the test results.

C-2.4 The lot shall be considered to conform to the requirement on crushing load if ($\bar{X} - 0{\cdot}4\,R$) is greater than or equal to the minimum crushing load specified in Table 6 for the particular ball size.

C-2.5 The lot shall be considered as conforming to the requirements of this standard if the conditions mentioned in **C-2.1** and **C-2.4** are fulfilled.

EXPLANATORY NOTE

Steel balls find a wide usage as rolling elements in engineering applications. The usage may be in the form of rolling bearings or as element directly between surfaces when it is desirable to reduce friction as in bicycles, scooters and instruments.

This standard was first published in 1965. Now it has been decided to revise it in order to align with ISO 3290-1975 'Rolling bearings — Bearing parts — Balls for rolling bearings', issued by the International Organization for Standardization (ISO) and to meet the demands from various manufacturers of balls as well as users to widen the scope of the earlier version.

It has been found more convenient to use electrical devices for measuring surface texture of balls. The device may either be carrier modulated or frequency modulated. The pick up traverse should be accomplished by mechanical means. It is recognized that other characteristics, such as waviness and surface appearance, are also essential for the quality of balls for rolling bearings. Such requirements are not covered by this standard.

This standard closely conforms to ISO 3290-1975. In this revision nine grades of balls have been specified which cover majority of common usages. The following are the equivalent grades between the earlier and the present version of this standard:

Grades in Earlier Version	*Equivalent Grade in the Present Version*
2	5
1	10
0	20
00	200

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